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(71) Applicant: **BSH Bosch und Siemens Hausgeräte GmbH**
81669 München (DE)

(72) Inventors:
- **Leukhardt III H. Alan,**
  CA 91750 (US)
- **Uy Dindo S.,**
  North Hollywood, CA 91602 (US)

(54) Pulsed sequence burner control with valve

(57) A cooking appliance with a cooktop including at least one gas burner includes a control for sequentially delivering gas and igniting the gas to burner ports. The control comprises a valve with a responsive element for controlling gas flow to the burner ports, an ignition module for generating a drive signal to an ignitor, an electronic controller interfacing with the ignition module and coupled to a driver for actuating a responsive element in the valve. The driver that causes displacement of the responsive element includes a pick up actuator enabling the responsive element to initiate a status that opens the passageway. The valve also includes a holding actuator that enables the responsive element to maintain the status of the passageway as open when flame is detected at the burner.

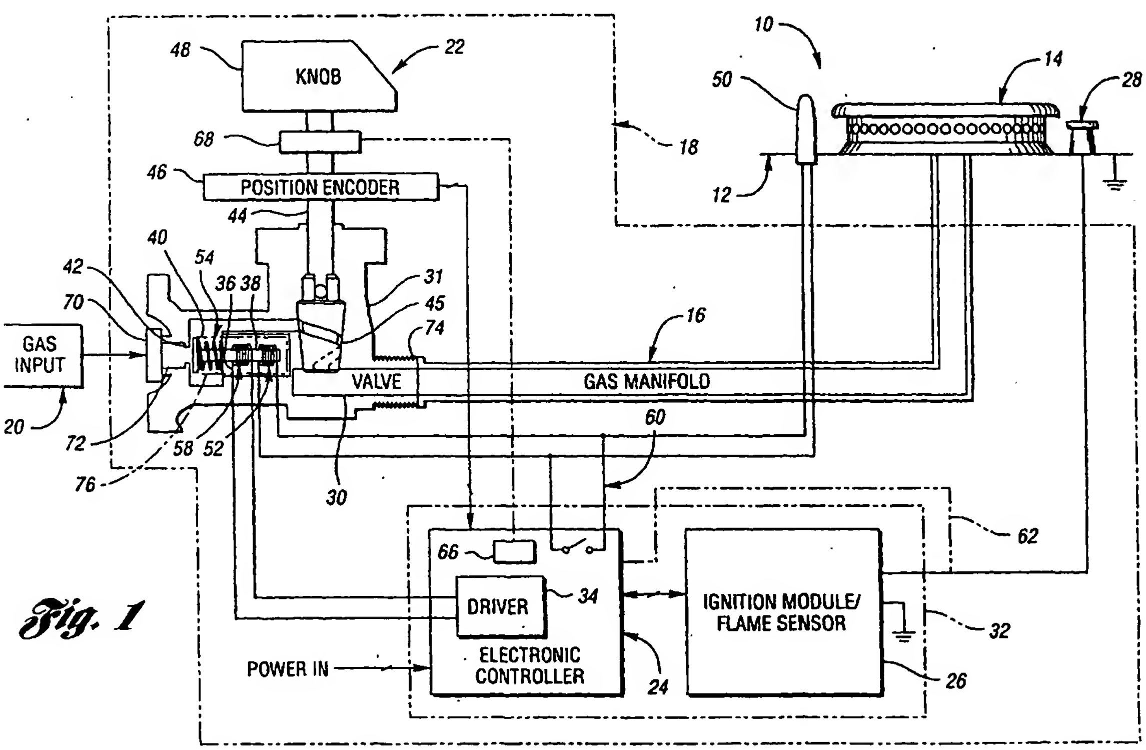

Fig. 1

EP 1 215 441 A2

Description

TECHNICAL FIELD

[0001] The present invention relates to cooking appliances having a cooktop with gas burners to which the gas flow and ignition of the gas flow is adjustable and assisted by a controller having a microprocessor for control of drivers for actuating elements that control the flow rate as well as the timing of the flow.

BACKGROUND ART

[0002] In most standard surface gas burner systems, whether used in counter cooktops or the cooktop portion of ranges, the flame is manually adjustable from a high output rating to a minimum output rating. The minimum output rating is the flow rate at which a small flame can be sustained at the burner ports without nuisance extinction. For most existing burner systems, the minimum output rating is in the range of 800 to 1500 BTU/hr.

[0003] One previously known attempt to obtain an output rating lower than most existing burner systems was to segregate gas flows by using dual burner heads. A small simmer head is placed in the center of a larger burner ring. This burner system is used in conjunction with a manual valve that has two valves internally. In the simmer mode, the outer ring is not used. The central burner provides the low output required for simmering. One big drawback of this system is the complexity of the gas piping system. There are two feeding pipes from the manual valve to the burner head. The burner head, as previously discussed, is actually two heads and the manual valve is actually two valves in one. Another disadvantage is that the central simmer head poses a performance deficiency in that the heat from a sustained flame is concentrated in a very small area. As a consequence, hot spots are created that may be hot enough to scorch a food item being simmered.

[0004] Another improvement providing lower energy output, for example a Thermador XLO burner system, provides sustainable flame control by cycling the flame on and off in order to achieve a heat output rating lower than what can normally be achieved using only limited range rate, controlled standard burner systems. This avoids complicated piping and may be incorporated with a cooktop construction with a standard size burner head. The heat is dissipated more evenly and the severity of hotspots is eliminated.

[0005] The previous system utilizes a manual valve that turns 280° counterclockwise. The valve is on HI at the 90° mark providing maximum flow through the valve. Further rotation reduces the gas flow to the burner as the valve is turned toward a minimum opening permitting a low flow rate at which the flame can be sustained at the burner. The unmodulated gas flow output is then kept constant as the valve is turned from 210° to 280°. Between 210° and 280°, the micro controller generates a valve control signal sequentially opening and closing a solenoid driven valve. For example, in a system that uses a 60 second period as its time base, at 210°, the flame is turned on for a predetermined time, e.g. 54 seconds, out of every 60 seconds. At 280°, the flame is turned on 7 seconds, out of every 60 seconds. The on times vary linearly between the 210° mark and the 280° mark. The signal is delivered to a solenoid driven valve connected between the manual gas valve and the burner head. The controller determines when to open the solenoid. The position of the manual valve is indicated to the controller by a potentiometer that is carried on the manual valve and operable for response variation as the user rotates the manual valve stem. The solenoid valve is powered by the electronic controller which in turn is energized by the mains power. Accordingly, the previous system is inoperational during a power outage because the solenoid valve is closed when not energized.

[0006] Moreover, the multiple valve bodies require additional gas path couplings that must be sealed and maintained throughout the useful life. Moreover, automating operation of the previous supply valve would require such high force actuation that coils or the like would be too large to package conveniently or to build in a reasonable cost consumer product.

Another type of known valve control, for example, cooktop controls of certain European manufacturers, utilize an integrated cut-off solenoid valve. The solenoid valve is comprised of a magnetic coil and a plunger with a rubber seal at one end that is displaced to allow or prevent the flow of gas. The solenoid is used in conjunction with a thermocouple mounted close to the burner head that generates the power to energize the solenoid.

[0007] In operation, the valve stem or knob is pushed down and turned counterclockwise. The pushing action pushes the solenoid plunger open and against the biasing spring force that pushes the plunger closed. The opening of the plunger allows gas to flow to the burner head. The gas is then ignited by an independent ignition system. The resulting flame heats up the thermocouple which generates an output to energize the coil and hold the plunger open. At this point, the user can stop pushing on the valve knob and the flame should be sustained. In the case that the flame in the burner head is extinguished, the thermocouple cools and the output generated drops until it releases the plunger to close, stopping the gas flow. This is a cut-off feature that prevents the escape of unignited gas. However, such a control is not a control for reducing energy output during cooking, and does not address the problems of hotspots or low energy flame control. Morever, such valves are physically designed to handle substantially less operating cycles (opening and closing) than would be required in a sequencing operation over a reasonable appliance service life, for example, tens of thousands of cycles over many years, where the valve closing and opening cycle repeats every minute during operation.

DESCRIPTION OF THE PRESENT INVENTION

[0008] The present invention overcomes the above-mentioned disadvantages by providing an electronic controller and a valve with an actuator for controlling both the timing and the flow rate of gas delivery through the valve to the burner. The cooktop control actuator may include a driver for a valve that opens and closes the flow of gas toward the burner and a driver which provides a range of control for the flow rate of gas to the burner, preferably within a single valve housing package.

[0009] The cut-off solenoid valve previously known may be modified in order to, for example, respond to an external electronic controller to pull in the plunger, control closing and opening of the gas flow. To reduce the size and power required to operate previously known valve structures, materials features such as wear-resistant, physical coatings and surface hardness characteristics may be added to reduce resistance that creates electrical losses, and thereby minimize coil size and packaging requirements. In addition, a thermocouple provides high energy power to the coil to take over in holding the plunger open once the plunger is open and a flame is established. Moreover, the valve is coupled so that the electronic controller may interrupt the output from the thermocouple to release the plunger and stop the gas flow.

[0010] The present invention provides the advantages of the existing cut-off solenoid valve, and also the advantage of using the valve as the cycling valve for the pulsed sequence burner operating feature. The preferred embodiment of the present invention eliminates the need for a separate external solenoid valve and at the same time, improves the previously known sequencing feature by adding an extra level of flame control as well as a feedback control from the burner. Unlike the simple cut-off solenoid valve system discussed in the previous section, the user does not need to hold down the knob while the thermocouple heats up when a flame is first established, since the electronic controller drives the actuator to open the valve and keeps the plunger open to allow the flow of gas during the initial heat up of the thermocouple.

[0011] Additionally, the present invention allows the use of the burner in the event of a power outage, whereas the existing XLO system does not. In the preferred embodiment, if the burner flame is already generated when a power interruption occurs, the burner will remain lit. On the other hand, if the flame is off, for example, because it is in the off portion of a sequencing cycle, then the burner will remain unlit. If the burner is not flaming when the power is interrupted, the knob may be pressed down while the flame is manually lit with a match. After ignition, the knob may be pushed down for a time, for example, a couple of seconds, until the thermocouple generates enough energy to hold the safety valve open. At this point, the user can release the knob and the burner should operate normally, except without the pulsed sequencing feature. Regardless of the presence of the mains power, the system avoids gas releases after inadvertent flame extinction.

[0012] In a preferred embodiment, a solenoid valve of the previously known type is modified by the addition of a pickup coil. The pickup coil will be energized by the electronic control. Once the plunger opens, the microcontroller drive signal to the pickup coil can be reduced to a holding value. In addition, as soon as the output of the thermocouple gets to a level high enough to energize the existing holding coil, the power to the pickup coil is turned off. In order to release the plunger, the controller may short out the output of the thermocouple, thus de-energizing the holding coil and releasing the plunger to close the valve. Alternatively, the controller may provide a drive signal to the pickup coil with a power whose magnitude is at least equivalent to that produced by the thermocouple but opposite in polarity. The opposite power will generate a magnetic field that will negate the magnetic field produced by the thermocouple, thus releasing the plunger. In either event, the controller permits pulsed sequencing of the gas flow when electrical power is available and incorporates flame shut off capability without requiring electrical power to operate the gas burner appliance.

BRIEF DESCRIPTION OF THE DRAWING

[0013] The present invention will be more clearly understood by reference to the following detailed description of the preferred embodiment when read in conjunction with the accompanying drawing in which like reference characters refer to like parts throughout the views, and in which:

FIGURE 1 is a schematic diagram of the cooktop control system according the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] Referring first to Figure 1, a cooktop is shown comprising a cooktop burner system 10 in which the cooktop panel 12 includes at least one gas burner 14. The burner 14 is coupled in fluid communication to a gas manifold 16, and a control 18 for a delivery of gas to the manifold is described in detail below. The control 18 includes valve actuator 22 and an electronic control module such as the microprocessor based controller 24. In addition, the control 18 includes an ignition control module 26 for operating the ignitor 28 that is positioned adjacent to burner 14 on the cooktop panel 12.

[0015] The electronic controller 24 is adapted to control responsive elements in a valve 30 which also includes manual inputs as well known in the previous sequenced burner of U.S. Patent 5,765,542. Preferably, the electronic controller 24 and the ignition module 26

are housed in a single control package 32 for convenient arrangement and interconnection with the other parts of the control 18. In addition, the valve 30 may be of various types of construction, although as schematically represented in Figure 1, includes at least one responsive element responsive to a driver 34. The valve is preferably carried in a single housing body 31, for example, as is accomplished in a Sourdillon Valve Model 099, including a cut-off valve and a flow rate adjuster. The responsive element 36 in the preferred embodiment is a pick-up coil 58, although other electronically driven devices could also be employed. The responsive element 36 controls at least one valve actuator, for example, plunger shaft 38, for controlling the connection between the gas supply 20 and the gas manifold 16.

[0016] In the preferred embodiment shown in Figure 1, the responsive member 36 includes the plunger shaft 38 acting as a valve stem that carries a valve head 40 for displacement into contact with and away from the valve seat 42. Closure of the valve head 40 against the valve seat 42 obstructs the flow of gas input between the supply 20 and the gas manifold 16. In addition, the valve construction shown in Figure 1 includes flow rate adapter that varies the amount of gas that can be passed from the supply 20 to the gas manifold 16 and into the burner 14. For example, the actuator 22 may include a tapered valve stem with a flow control channel that controls the amount of blockage of the flow passageway through the valve 30 from its inlet 72 to its outlet 74. Both the valve head 40 and the valve stem control chamber are within the flow passage through the valve body from its inlet 72 to its outlet 74. The plunger shaft 38, holding coil 52 and pick-up coil 58 are carried in a chamber sealed by cap 70. Preferably, these parts are carried in a cartridge 76 for simple installation within the chamber. For example, the cartridge 76 may be constructed to replace the valve components provided with the Sourdillon valve Model 099, without otherwise changing the valve body, but replacing the original coil actuator with both coil actuators of the preferred embodiment.

[0017] The position of the valve stem 44 is relayed by a position encoder 46, preferably a potentiometer when a simple electrical circuit incorporating previous controls is desired, coupled to the electronic controller 24, although other counters or devices may be used. In the preferred embodiment, the stem is actuated by a knob 48. Nevertheless, other types of controls such as touch sensitive switches or the like may be used as an actuator 22 without departing from the present invention. In any event, the feedback from the actuator 22 to the controller 24 advises the controller 24 of the flow rate of gas to be delivered to the burner as will be discussed in detail below.

[0018] The cooktop 12 also includes a thermocouple 50 adjacent the peripheral ports of the burner 14. The thermocouple 50 generates a current in response to the presence of a flame at the thermocouple that is delivered to a holding coil 52 acting upon the valve shaft 38. So long as the flame is sustained to generate heat at the burner 14, the thermocouple 50 generates sufficient current to hold the solenoid core of the plunger shaft 38 in a retracted position from the valve seat 42. Of course, the valve head 40 may be resiliently biased, for example by the spring 54, toward the seat 42 to shut off the flow of gas in the event that electric power is not available to the ignitor 28 or to the controller 18 for the gas valve. The holding coil 52 is sufficiently large to be energized so that it overcomes the biasing force, for example, the force of the spring 54, to displace the shaft 38 to its retracted position.

The position encoder 46 may be an analog device such as a potentiometer or a digital device such a binary encoding counter, without departing from the present invention. The position of the valve stem 44 determines the amount of gas within the predetermined range of flow rates for the gas delivered to the manifold 16 for controlling the amount of heat released at the burner 14 in the preferred embodiment. In the preferred embodiment, the knob 48 is turned to open the valve to a wide-open position for easy ignition by the ignitor 28. For example, the position encoder 46 may signal that actuation of the knob 48 is to initiate flame kernel generation at the ports by the ignitor 28, for example, a sparking ignitor, as the movement of stem 44 opens the passageway between the valve seat 42 and the gas manifold 16. At the same time, the driver 34 generates a drive signal to the pickup coil 58 and releases the valve head 40 from the valve seat 42. Accordingly, gas input from the supply 20 may be delivered through the valve and the manifold to the burner ports at the burner 14.

[0019] Preferably, the controller 24 drives the ignitor 28 to repeatedly generate a charge until a flame sensor, for example, the thermocouple 50 as shown at 60, or a dedicated ignition sensor incorporated in the ignitor as designated at 62, determines that a flame has been generated at the adjacent ports of the burner 14. Morever, once the thermocouple 50 has been heated to continuously generate a signal to the holding coil 52, the driver 34 of the controller 24 is switched off, while the valve head 40 remains retracted from the valve seat 42 by the force in the holding coil 52. Alternatively, the ignitor 28 may be an electronic spark module for ignition, for example, a hot surface ignitor, that may or may not cycle with the flame when using the pulsed sequence feature.

[0020] As indicated in Figure 1 at 60, a flame sensing feature of the ignitor 28 may be directed to the electronic controller 24 so that if the burner fails to generate a flame after a predetermined number of charges have been delivered to the ignitor 28, the controller 24 may generate a response for example, to power the pickup coil 58 or to power the holding coil 52. For example, if the output of the thermocouple 50 gets to a level high enough to energize the existing holding coil 52, the power to the pickup coil 58 may be turned off. In order to release the plunger, the controller 24 shorts out the output of the

thermocouple 50, de-energizing the holding coil 52 and permitting the valve head 40 to close against the valve seat 42 when the electronic controller 24 determines that a pulse sequence operation is required.

[0021] Alternatively, the controller 24 may provide a drive signal to the pickup coil 58 with a power whose magnitude is equivalent to that produced by the holding coil 52 but opposite in polarity so that an opposite force magnetic field will negate the magnetic field produced in the coil by the current from the thermocouple 50. In either event, the controller 24 permits pulsed sequencing of the gas flow in a well known manner when electrical power is available. Moreover, the system provides a flame cut-off capability in the event that ignition of gas at the burner 14 cannot be sustained with a continuous flame. Morever, the burner 14 may be still be operated without electrical power if the thermocouple 50 detects existence of a flame so that the holding coil 52 maintains the valve head 40 in a retracted position from the valve seat 42.

[0022] Moreover, the control of flow sequencing as well as flow rate may be further automated. For example, a valve as used in the preferred embodiment may be modified by incorporating a driver 66 for delivering a power signal to a displacer 68 on the stem 44 in a manner that varies the flow rate, for example, turning the valve body 45 for variable passage capacity where a modern user interface, such as a touch-sensitive switch panel, is desired. Alternatively and preferably, an automated control of the flow rate could be most conveniently be produced as responsive to an electronic controller by using a proportional gas valve that varies the gas flow proportional to an electrical current or voltage applied to an actuator by the controller.

[0023] Having thus described the present invention, many modifications will become apparent to those skilled in the art to which it pertains without departing from the scope and the spirit of the present invention as defined in the appended claims.

Claims

1. A cooktop control for a cooking appliance including a cooktop having at least one gas burner having a plurality of ports, at least one ignitor adjacent to at least one port on the burner; and a control for sequentially delivering gas to the burner ports and igniting the gas at burner ports, said control comprising:

    a valve and a responsive element in said valve for controlling gas flow through a passageway coupled in fluid communication with said plurality of ports;

    an ignition module for generating a drive signal to the at least one ignitor;

    an electronic controller interfacing with said ignition module and coupled to a driver for actuating said responsive element;

    wherein said driver enables said responsive element to default to a status that closes said passageway, wherein said driver comprises a pick up actuator that enables said responsive element to initiate an open position status that opens said passageway, and a holding actuator that enables said responsive element to maintain an open position status;

    a sensor for detecting the presence of flame at said burner port and coupled to said holding actuator and said electronic controller; and

    wherein said driver is responsive to each of said controller and said sensor to displace said responsive element from said default status to said open position status.

2. The invention as described in claim 1 wherein said open position status comprises a timed pulse period in a sequence of timed pulses.

3. The invention as described in claim 1 wherein said responsive member comprises a solenoid coil.

4. The invention as described in claim 3 wherein said driver comprises a circuit delivering electrical current to said coil.

5. An automated cooking appliance having a cooktop comprising:

    a cooktop panel;

    at least one burner supported for exposure at said cooktop panel and sealed to said panel;

    a gas manifold connectable to a gas supply for delivering gas to said burner;

    a valve for controlling the gas flow from said supply to said manifold;

    an ignitor for generating a flame at said burner;

    an electronic controller including a driver for said valve and an ignition module for driving said ignitor; and

    at least one flame sensor at said burner for generating a response in said valve driver.

6. A burner control for a cooktop with at least one gas burner, and a manifold for delivering gas to said at

least one gas burner, the control comprising:

at least one valve including a responsive member for controlling displacement of head with respect to a valve seat in fluid communication with said manifold;

an electronic control including a driver for actuating said responsive member, and a pulsed sequence control for said driver;

a sensor for detecting the presence of flame at said burner and generating an indication; and

a feedback signal for actuating said driver in response to said indication.

7. The invention as described in claim 6 wherein said pulsed sequence control selectively applies said feedback signal to said driver.

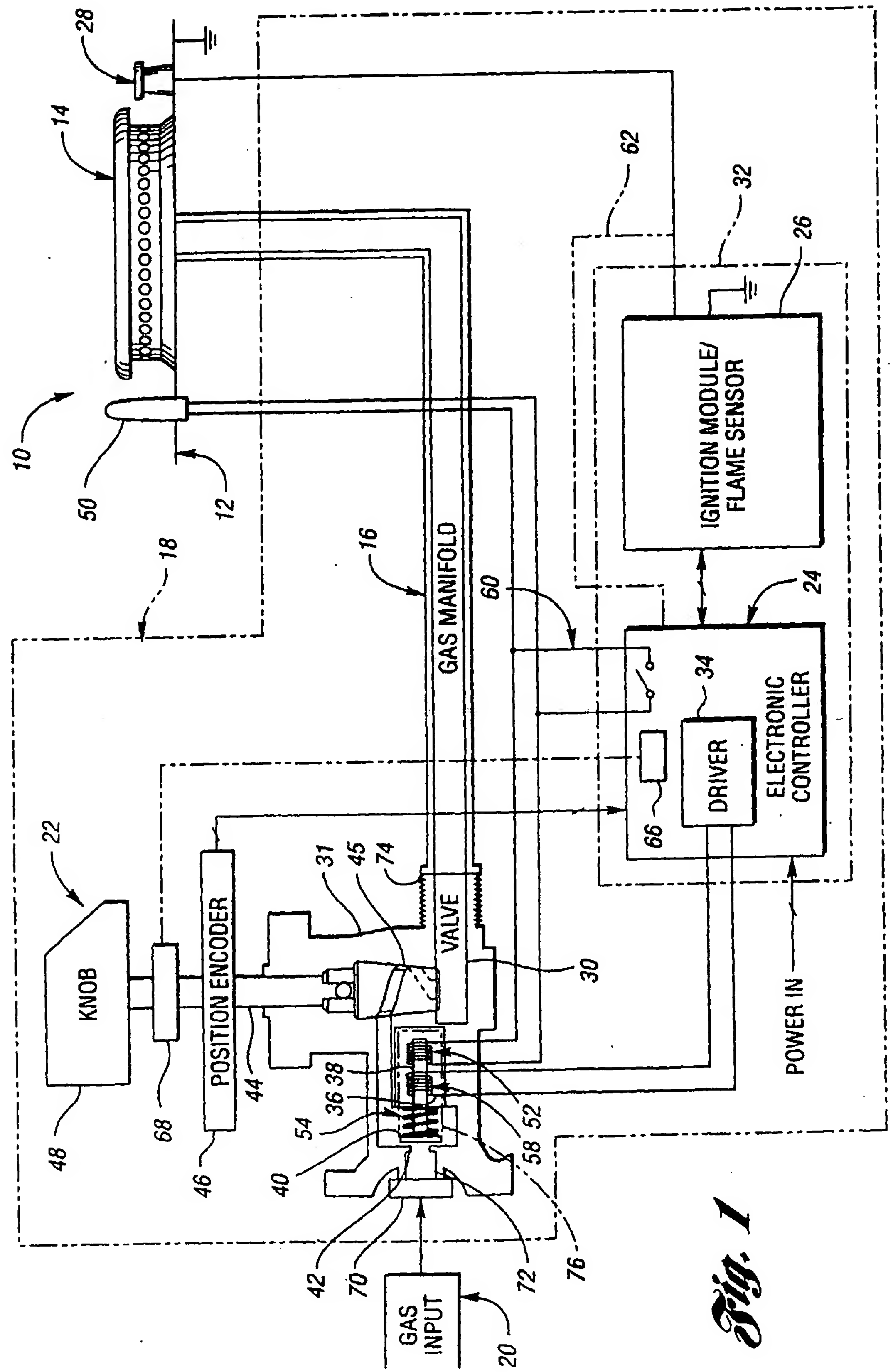
KNOB
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Fig. 1

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